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Accurate and Objective Lecturer Appraisal System: Implementation of the LOPCOW Method

Ummu Radiyah[1], **Lise Pujiastuti**[2], **Sumanto**[3*], **Ahmad Yani**[4], **Adi Supriyatna**[5], **Lita Sari Marita**[6], **Ruhul Amin**[7]

[1,7] Department of Informatics, Faculty of Engineering and Informatics, Universitas Nusa mandiri, Jakarta, Indonesia
[2] Department of Information System, Faculty of Engineering and Informatics, STMIK Antar Bangsa, Kota Tangerang, Banten
[3*] Department of Informatics, Faculty of Engineering and Informatics, Universitas Bina Sarana Informatika, Jakarta, Indonesia
[4,5] Department of Accounting Information System, Faculty of Engineering and Informatics, Universitas Bina Sarana Informatika, Jakarta, Indonesia
[6] Department of Information System, Faculty of Engineering and Informatics, Universitas Bina Sarana Informatika, Jakarta, Indonesia

Abstract

Abstract This research proposes the use of the Logarithmic Precursor Chain-Driven Objective Weighting (LOPCOW) method to evaluate the best lecturers in universities. The selection of outstanding lecturers in higher education institutions faces challenges such as subjectivity, inefficiency, and the lack of objective criteria and methods. Many universities struggle with inefficient and time-consuming manual assessments. The LOPCOW method ensures that the assessment covers all aspects of lecturer quality and performance, including education, research, community services, discipline, commitment, cooperation skills, and innovation. The research involved several stages: defining evaluation criteria, collecting data, applying the LOPCOW method, and analyzing the results. Data used in this study included scores and ratings of lecturers based on the defined criteria. The evaluation showed that CDE lecturers were the best, with the highest score of 0.715, demonstrating high consistency in education, research, and community service. This was followed by MNO lecturers (0.676), STU lecturers (0.668), XYZ lecturers (0.637), and AFI lecturers (0.627). The results indicate that highly ranked lecturers exhibit strong dedication to the Tridharma of higher education, with consistent performance and a positive impact on the academic community and the general public. This research aims to improve lecturers' quality and productivity by providing a more accurate and comprehensive assessment. Future research should focus on developing strategies to enhance teaching quality through new educational technologies and evaluating their impact on student learning. The findings of this study can benefit higher education institutions by offering a robust method for lecturer evaluation, leading to better recognition and rewards for outstanding educators.

Keywords: *DSS, outstanding Lecturer, SPK, lopcow, MCDM*

1. Introduction

A lecturer carries out Tri Dharma of Higher Education, namely, organising education, conducting research and development in the fields of science and technology, and carrying out community service activities [1]. Because these tasks are very complex, awards are needed to improve the quality and advance science. This award also motivates lecturers to be more productive and innovative in developing higher education [2]. In addition, the selection of outstanding lecturers is an important process in higher education

institutions that aims to recognise and motivate academic staff to excel in their roles. However, this process often faces challenges such as subjectivity and inefficiency when done manually [3]. The selection of the best lecturers must be in accordance with the set criteria and can be used to measure lecturer

*Corresponding author. *E-mail address: sumanto@bsi.ac.id*
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performance. Criteria are an important factor in choosing the best lecturer [4]. The criteria are requirements that must be met and implemented by every lecturer. Thus, the goals of state and private universities can be achieved [5]. The problem of selecting outstanding lecturers is multifaceted and involves challenges, such as subjectivity, inefficiency, and the need for objective criteria and methods. Many universities face difficulties owing to the lack of efficient terms, procedures, and systems to evaluate lecturers' achievements, often relying on time-consuming and subjective manual assessments [6], [7]. To overcome this problem, various decision support systems and methods have been proposed. Computer-based tools called Decision Support Systems (DSS) help decision-making in organisations or companies by solving various problems, both unstructured and semi-structured, using data and models [2].

The selection of outstanding lecturers can be significantly improved using robust decision-making methods such as the logarithmic precursor chain-driven objective weighting (LOPCOW) method. This method can be highly effective in overcoming the multi-criteria decision-making (MCDM) challenges inherent in such selection. The LOPCOW method, which involves computing objective weights based on logarithmic percentage changes, can be integrated with existing methods, such as Simple Additive Weighting (SAW) and the Analytic Hierarchy Process (AHP), to improve accuracy and objectivity. For example, the SAW method has been effectively used in various contexts to assess lecturers' performance based on various criteria, such as education, research, and community services, ensuring a comprehensive evaluation [8], [9]. Similarly, AHP has been used to handle subjective judgment and pairwise comparisons, providing a structured approach to decision-making [10], [11].

The LOPCOW method can further refine this assessment by optimising the weighting factors using a constrained optimisation problem, as shown in the context of the best selection decision [12]. This approach ensures that personal preferences and objective data are balanced, which leads to accurate and fair results. In addition, combining the fuzzy set theory and the Hamming distance method can overcome uncertainty and incomplete information, thereby improving the robustness of the selection process [13]. By leveraging the strengths of these methods, the LOPCOW method can provide a more nuanced and precise evaluation of lecturer performance, ultimately leading to better recognition and rewards for outstanding educators. This comprehensive approach is in line with the goal of improving teaching quality and fostering academic excellence in higher education institutions [14], [15]. Using LOPCOW, decisions can be made more accurately because they accommodate fluctuations and changes that occur in the environment or situation being assessed. This method can be a useful tool for considering the dynamic aspects of decisions in various contexts, ranging from alternative selection to resource allocation. One of the main advantages of the LOPCOW method is its ability to dynamically adjust criteria weights based on relative changes in objective data. This approach allows decision support systems to remain relevant and accurate in making decisions in changing environments [16]. In addition, LOPCOW can overcome the problems of uncertainty and fluctuations that occur in the decision-making process so that the decision results become more reliable [17]. Thus, LOPCOW can help organisations or individuals make better and more informed decisions in various contexts and situations [18]. The LOPCOW method can further refine this assessment by optimizing the weighting factors using a constrained optimization problem, as shown in the context of the best selection decision. This approach ensures that personal preferences and objective data are balanced, leading to accurate and fair results. Additionally, combining the fuzzy set theory and the Hamming distance method can overcome uncertainty and incomplete information, thereby improving the robustness of the selection process.

This research aims to develop and apply the Logarithmic Precentage Chang Driven Objective Weighting (LOPCOW) method to assess the best lecturers in university as a whole in Indonesia. The LOPCOW method was used to ensure that the assessment covered all aspects of lecturer quality and performance, including education, research, community services, discipline, commitment, cooperation skills, and innovation. It is hoped that LOPCOW will overcome the weaknesses of previous assessment methods that are not thorough, thus providing a more accurate and comprehensive assessment of exemplary lecturers. The main objective was to improve lecturers' quality and productivity in various fields.

2. Methods

This research was conducted through a series of planned and structured steps to solve the problems discussed above. The research stages start collecting data, determining the weight of criteria using LopCow, the grey relational analysis method, and outstanding lecturer rangking. The research stages are illustrated in Figure 1.

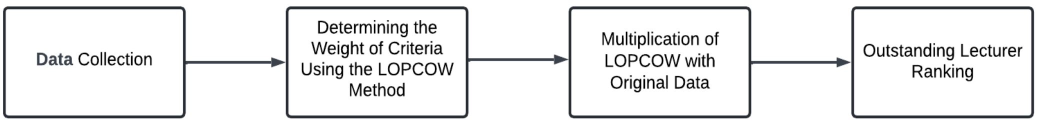

Figure 1. Research Stages

A. Data Collection

Once the problem is defined, relevant data must be collected from various sources such as internal campuses, external campuses, and other data sources. The collected data must be accurate and complete to support a comprehensive analysis. The collected data were then processed and cleaned for analysis. This includes verifying the data, dealing with missing data, and changing the data formats. The processed data were then analysed to identify the patterns and trends relevant to the problem.

B. Determining the Weight of Criteria Using the LOPCOW Method

The LOPCOW method is a multicriteria decision-making technique based on changes in logarithmic percentages in determining the relative weights. Equation (1) is a decision matrix created in the first process of the LOPCOW method.

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Equation (2) shows the calculation of the matrix normalisation value in the second process of the LOPCOW method.

$$n_{ij} = \frac{x_{ij}}{m + \sum_{i=1}^{m} x_{ij}^2} \quad (2)$$

This formula is used to normalize the value xijx_{ij}xij. The original value xijx_{ij}xij is divided by the sum of mmm plus the sum of the squares of xijx_{ij}xij values for all iii in criterion jjj. This normalization helps to ensure that each xijx_{ij}xij value is proportionally evaluated against the total sum of other xijx_{ij}xij values, allowing for fair and consistent comparison among the elements.

Equation (3) calculates the preference value in the third process of the LOPCOW method.

$$PV_i = 100 * \left| \frac{\sqrt{\sum_{i=1}^{m} n_{ij}^2}}{\ln \frac{m}{\sigma}} \right| \quad (3)$$

Equation (4) calculates the final weight of the criteria in the final process of the LOPCOW method.

$$w_i = \frac{PV_i}{\sum_{j=1}^{n} PV_i} \quad (4)$$

This final weight is used to evaluate the available decision alternatives by multiplying the criterion value of each alternative by the corresponding criterion weight and then summing the results to obtain the final score of each alternative.

C. Multiplication of LOPCOW with Original Data

In this process, multiplication is carried out between the weight results obtained from LOPCOW and the original data so that the resulting value is a reference for providing outstanding lecturers. The equations used in this stage are as follows.

$$x_{11} = x_{11} * w_1 \quad (5)$$

D. Outstanding Lecturer Ranking

The ranking of outstanding lecturers was conducted using multi-criteria methods such as Grey Relational Analysis (GRA) to ensure an objective and comprehensive evaluation. The process begins by identifying the relevant evaluation criteria. Data for each criterion were collected and normalised to scale consistency. Next, grey relational coefficients are calculated to measure the closeness of each lecturer to the ideal solution, followed by the calculation of the Gray Relational Grade (GRG) which is the average of the coefficients. Lecturers with the highest GRG scores are considered top performers, as they demonstrate performance closest to the set ideal standard. This method ensures that decisions are based on a systematic and objective analysis of various aspects of the lecturer’s performance.

3. Result and Discussion

3.1. Research Data

The data used in this study as an alternative were lecturer data at ABC universities from the to 2020-2023 academic year, with a total sample of 15 outstanding lecturer candidates equipped with initial names. Details of the lecturer data are shown in Table 1, for the criteria used in Table 2, and for the complete data between the criteria and alternatives in Table 3.

Table 1. Alternative Data for Lecturer Candidate Achievement

No.	Initial	Name
1	AFI	Adi Fajar Insani
2	BTI	Bayu Tri Wibowo
3	CDE	Cindy Dwi Erlangga
4	EFG	Eka Febriani Gunawan
5	GHI	Galih Hadi Ibrahim
6	IJK	Indah Julianti Kurniawan
7	KLM	Kevin Leonardo Manurung
8	MNO	Maria Nisa Oktavia
9	PAK	Putri Amalia Kusuma
10	QRS	Qorry Rizky Syahid
11	STU	Santi Tri Utami
12	UVW	Udin Wahyudi
13	XYZ	Xenia Yuliana Zahra
14	ABC	Ade Budi Cahyono
15	DEF	Dian Eka Fitriani

Table 2. Criteria for Outstanding Lecturers

Kriteria	Keterangan
C1	Education
C2	Research
C3	Community Service
C4	Discipline
C5	Committees
C6	Cooperation Skills
C7	Ability to innovate

The process of selecting the best lecturer candidates included 15 alternatives that were used as calculation samples. The weight values of each criterion are listed in Table 3 and the alternative data are listed in Table 4.

Table 3. Weight value of Outstanding Lecturer Criteria

Criteria	Description	Benefit/Cost	Criteria	Description	Benefit/Cost
	S3	3		Good	3
C1	S2	2	**C4 & C6**	Simply	2
	S1	1		Less	1
	Active	3		High	3
C2 & C3	Simply	2	**C5 & C7**	Medium	2
	Less	1		Low	1

Table 4. Alternative Data and Criteria for Outstanding Lecturers

No.	Inisial	C1	C2	C3	C4	C5	C6	C7
1	AFI	S2	Active	Active	Good	Medium	Good	High
2	BTI	S1	Simply	Simply	Simply	High	Simply	Medium
3	CDE	S3	Active	Active	Good	High	Good	High
4	EFG	S2	Active	Simply	Simply	Medium	Good	Medium
5	GHI	S1	Simply	Simply	Good	Medium	Good	Medium
6	IJK	S2	Active	Active	Simply	High	Simply	High
7	KLM	S1	Simply	Simply	Good	Medium	Simply	Medium
8	MNO	S3	Active	Active	Simply	High	Good	High
9	PAK	S2	Active	Simply	Good	Medium	Good	Medium
10	QRS	S1	Simply	Simply	Simply	Medium	Simply	Medium
11	STU	S2	Active	Active	Good	High	Good	High
12	UVW	S1	Simply	Simply	Good	Medium	Good	Medium
13	XYZ	S3	Active	Active	Simply	High	Simply	High
14	ABC	S2	Active	Simply	Good	Medium	Good	Medium
15	DEF	S1	Simply	Simply	Good	Medium	Good	Medium

3.2. Application of the LOPCOW Method in Determining Criteria Weights

The application of the LOPCOW method to determine criteria weights aims to provide a more objective approach for determining the relative significance of each criterion. By analysing the logarithmic percentage change in objective criteria values, this method can accommodate significant changes and avoid biases that may occur when determining weights. Through this approach, decisions regarding criteria weights can be based on stronger and more measurable empirical data, thus enabling more accurate and objective decision-making in the context of assessment or selection.

The first stage in the LOPCOW method is to create a decision matrix as follows.

$$\begin{bmatrix} X_{11} & X_{21} & X_{31} & X_{41} & X_{51} & X_{61} & X_{71} \\ X_{12} & X_{22} & X_{32} & X_{42} & X_{52} & X_{62} & X_{72} \\ X_{13} & X_{23} & X_{33} & X_{43} & X_{53} & X_{63} & X_{73} \\ X_{14} & X_{24} & X_{34} & X_{44} & X_{54} & X_{64} & X_{74} \\ X_{15} & X_{25} & X_{35} & X_{45} & X_{55} & X_{65} & X_{75} \\ X_{16} & X_{26} & X_{36} & X_{46} & X_{56} & X_{66} & X_{76} \\ X_{17} & X_{27} & X_{37} & X_{47} & X_{57} & X_{67} & X_{77} \\ X_{18} & X_{28} & X_{38} & X_{48} & X_{58} & X_{68} & X_{78} \\ X_{19} & X_{29} & X_{39} & X_{49} & X_{59} & X_{69} & X_{79} \\ X_{110} & X_{210} & X_{310} & X_{410} & X_{510} & X_{610} & X_{710} \\ X_{111} & X_{211} & X_{311} & X_{411} & X_{511} & X_{611} & X_{711} \\ X_{112} & X_{212} & X_{312} & X_{412} & X_{512} & X_{612} & X_{712} \\ X_{113} & X_{213} & X_{313} & X_{413} & X_{513} & X_{613} & X_{713} \\ X_{114} & X_{214} & X_{314} & X_{414} & X_{514} & X_{614} & X_{714} \\ X_{115} & X_{215} & X_{315} & X_{415} & X_{515} & X_{615} & X_{715} \end{bmatrix}$$

The Decision Matrix

$$\begin{bmatrix} 2 & 3 & 3 & 3 & 2 & 3 & 3 \\ 1 & 2 & 2 & 2 & 3 & 2 & 2 \\ 3 & 3 & 3 & 3 & 3 & 3 & 3 \\ 2 & 3 & 2 & 2 & 2 & 3 & 2 \\ 1 & 2 & 2 & 3 & 2 & 3 & 2 \\ 2 & 3 & 3 & 2 & 3 & 2 & 3 \\ 1 & 2 & 2 & 3 & 2 & 2 & 2 \\ 3 & 3 & 3 & 2 & 3 & 3 & 3 \\ 2 & 3 & 2 & 3 & 2 & 3 & 2 \\ 1 & 2 & 2 & 2 & 2 & 2 & 2 \\ 2 & 3 & 3 & 3 & 3 & 3 & 3 \\ 1 & 2 & 2 & 3 & 2 & 3 & 2 \\ 3 & 3 & 3 & 2 & 3 & 2 & 3 \\ 2 & 3 & 2 & 3 & 2 & 3 & 2 \\ 1 & 2 & 2 & 3 & 2 & 3 & 2 \end{bmatrix}$$

1.The first stage in the LOPCOW method is to create a decision matrix with (2) the decision matrix is as follows:

Table 5. Normalization Result of LOPCOW Method

Alternative	Criteria Value						
	C1	C2	C3	C4	C5	C6	C7
AFI	0.056	0.075	0.086	0.075	0.038	0.072	0.086
BTI	0.014	0.033	0.038	0.033	0.086	0.032	0.038

CDE	0.125	0.075	0.086	0.075	0.086	0.072	0.086
EFG	0.056	0.075	0.038	0.033	0.038	0.072	0.038
GHI	0.014	0.033	0.038	0.075	0.038	0.072	0.038
IJK	0.056	0.075	0.086	0.033	0.086	0.032	0.086
KLM	0.014	0.033	0.038	0.075	0.038	0.032	0.038
MNO	0.125	0.075	0.086	0.033	0.086	0.072	0.086
PAK	0.056	0.075	0.038	0.075	0.038	0.072	0.038
QRS	0.014	0.033	0.038	0.033	0.038	0.032	0.038
STU	0.056	0.075	0.086	0.075	0.086	0.072	0.086
UVW	0.014	0.033	0.038	0.075	0.038	0.072	0.038
XYZ	0.125	0.075	0.086	0.033	0.086	0.032	0.086
ABC	0.056	0.075	0.038	0.075	0.038	0.072	0.038
DEF	0.014	0.033	0.038	0.075	0.038	0.072	0.038

The results of the normalisation of all alternatives for each criterion in Table 5 are the calculated data from the matrix normalisation that has been done. The third stage of the LOPCOW method calculates the preference value using Equation (3). The results of the preference value calculations are as follows:

$$PV_1 = 100 * \left|\frac{0.258}{5.911}\right| = 100 * 0.044 = 4.364$$

$$PV_2 = 100 * \left|\frac{0.239}{6.599}\right| = 100 * 0.036 = 3.627$$

$$PV_3 = 100 * \left|\frac{0.239}{6.466}\right| = 100 * 0.037 = 3.697$$

$$PV_4 = 100 * \left|\frac{0.239}{6.599}\right| = 100 * 0.036 = 3.627$$

$$PV_5 = 100 * \left|\frac{0.239}{6.466}\right| = 100 * 0.037 = 3.697$$

$$PV_6 = 100 * \left|\frac{0.239}{6.678}\right| = 100 * 0.036 = 3.573$$

$$PV_7 = 100 * \left|\frac{0.239}{6.466}\right| = 100 * 0.037 = 3.697$$

Table 6. The Result of preference value calculation

C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**Total**
4.364	3.627	3.697	3.627	3.697	3.573	3.697	26.282

2. Equation (4) is the calculation of the final weight of the criteria in the final process of the LOPCOW method, based on the results of the calculated preference value. The results of the final weights of the criteria are as follows:

$w_1 = \frac{4.364}{26.282} = 0.166$, $w_2 = \frac{3.627}{26.282} = 0.138$,
$w_3 = \frac{3.697}{26.282} = 0.141$, $w_4 = \frac{3.627}{26.282} = 0.138$,
$w_5 = \frac{3.697}{26.282} = 0.141$, $w_6 = \frac{3.573}{26.282} = 0.136$,
$w_7 = \frac{3.697}{26.282} = 0.141$

Table 7. The Result of final weight of the criteria

C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**Total**
0.166	0.138	0.141	0.138	0.141	0.136	0.141	1.000

Equation (4) calculates the final weight of the criteria in the final process of the LOPCOW method based on the calculated preference values. The results show that the weights for the criteria (C1 to C7) are distributed as follows: 0.166 for C1, 0.138 for C2, 0.141 for C3, 0.138 for C4, 0.141 for C5, 0.136 for C6, and 0.141 for C7. These weights sum up to a total of 1.000, indicating a balanced distribution across the criteria. This balanced distribution ensures that each criterion is appropriately weighted in the overall evaluation process, contributing to a fair and comprehensive assessment.

3.3 Multiplication of LOPCOW with Original Data

The calculation using Equation (5) is the process of calculating the matrix normalisation value. The results of the overall matrix normalisation are shown in Table 8.

Table 8. Results of the overall Matrix Normalization

Alternatif	**Criteria Value**						
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
AFI	0.498	0.69	0.705	0.69	0.423	0.68	0.705
BTI	0.166	0.414	0.423	0.414	0.705	0.408	0.423
CDE	0.83	0.69	0.705	0.69	0.705	0.68	0.705
EFG	0.498	0.69	0.423	0.414	0.423	0.68	0.423
GHI	0.166	0.414	0.423	0.69	0.423	0.68	0.423
IJK	0.498	0.69	0.705	0.414	0.705	0.408	0.705
KLM	0.166	0.414	0.423	0.69	0.423	0.408	0.423
MNO	0.83	0.69	0.705	0.414	0.705	0.68	0.705
PAK	0.498	0.69	0.423	0.69	0.423	0.68	0.423
QRS	0.166	0.414	0.423	0.414	0.423	0.408	0.423
STU	0.498	0.69	0.705	0.69	0.705	0.68	0.705
UVW	0.166	0.414	0.423	0.69	0.423	0.68	0.423
XYZ	0.83	0.69	0.705	0.414	0.705	0.408	0.705
ABC	0.498	0.69	0.423	0.69	0.423	0.68	0.423
DEF	0.166	0.414	0.423	0.69	0.423	0.68	0.423

3.4 Outstanding Lecturer Ranking

Ranking outstanding lecturers is an important process for determining the order or ranking of lecturers based on predetermined evaluation criteria. The ranking steps involve identifying relevant evaluation criteria, collecting data using various methods, and processing the data to produce an accurate ranking. This method of analysis helps rank lecturers based on their performance, with lecturers who have the highest scores being considered the best. This ranking process helps organisations make better decisions in selecting the best lecturers by considering various aspects of performance objectively and systematically. Figure 2 shows the ranking results of the alternatives.

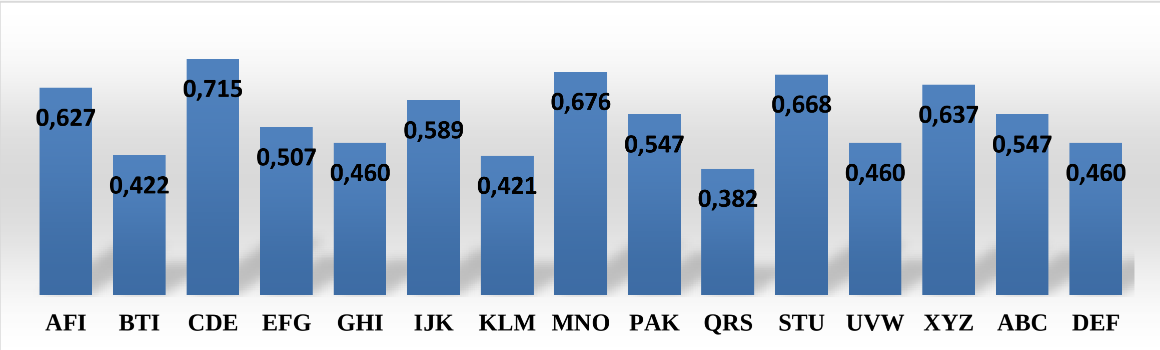

Figure 2. Alternative Ranking Results

The results of the ranking of the selection of outstanding lecturers show that the first-best lecturer was obtained by outstanding lecturers named CDE with a GRG value of 0.716, the second-best lecturer was obtained by outstanding lecturers with a GRG value of 0.676, and the third-best lecturer was obtained by outstanding lecturers Name STU with a GRG value of 0.668. The application of the LOPCOW method to rank outstanding lecturers results in a comprehensive and objective approach. The LOPCOW method is used to determine the relative weights of various criteria based on logarithmic percentage changes, which allows for weight adjustments based on the sensitivity of data changes.

4. Conclusion

Based on the results of the lecturer performance evaluation using the given scores and rankings, it can be concluded that CDE stood out as the best lecturer with the highest score of 0.715 and ranked first. They showed high consistency in all aspects assessed, especially in education, research, and community services. Following the MNO with a score of 0.676, they took the second position with excellent performance, showing strong dedication to the Tri Dharma of higher education. STU, which ranked third with a score of 0.668, also stood out in research and community services, showing a strong commitment to science development and community services. Fourth, XYZ, with a score of 0.637, also showed good performance in all evaluation criteria, particularly in terms of research and community services. Meanwhile, the AFI, which came in fifth place with a score of 0.627, showed strong performance in education and research, making a significant contribution to improving the quality of teaching in higher education. This conclusion underscores that highly ranked lecturers show strong dedication to the Tri Dharma tasks of higher education, with consistent performance and a positive impact on the academic community and the general public. Future research should focus on developing strategies to improve lecturers' teaching quality by implementing new educational technologies and evaluating their impact on student learning. In addition, it is important to further examine the factors that influence lecturers' research productivity and efforts to increase their involvement in community service projects that have a direct impact. The LOPCOW method has proven to be highly effective in this evaluation process, providing a comprehensive and objective assessment of lecturer performance. Therefore, it is recommended that the LOPCOW method be adopted as the best approach for evaluating lecturer performance in higher education institutions, ensuring accurate, fair, and thorough assessments.

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